Original Article

Goitre prevalence and the state of iodine nutrition in sundarban delta of north 24-parganas in West Benegal

Amar K Chandra PhD, Smritiratan Tripathy MSc, Dishari Ghosh MSc, Arijit Debnath MSc and Sanjukta Mukhopadhyay MSc

Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta

The main objective of this study was to assess the iodine nutritional status among school children (6-12 yrs) of Sundarban delta in North 24- Parganas district of West Bengal in eastern India. A total of 2050 children were clinically examined for goiter and 240 urine samples were analyzed for iodine and thiocyanate respectively; iodine content in 48 water samples and 210 salt samples were also measured. Results indicate that the studied region is clinically severely goiter endemic having goiter prevalence 33.1 % (grade 1: 30.4 %; grade 2: 2.7%), median urinary iodine level 200 μg/l indicating no biochemical iodine deficiency, 65.2 % salt samples contain recommended level of iodine and the iodine content in drinking water is sufficient while mean urinary thiocyanate level was 0.708±0.38 mg/dl. In spite of the consumption of adequate iodine, the existing goiter prevalence may be for the consumption of dietary goitrogens/antithyroid substances that possibly come through food and water.

Key Words: endemic goiter, goitrogens, school children, urinary iodine, urinary thiocyanate, West Bengal

Introduction

Iodine deficiency disorders (IDD) are a major public health problem all over world including India. Its major manifestations are endemic goiter, mental defects, deaf mutism, stillbirth and miscarriages, weakness and paralysis of muscles as well as lesser degree of physical and mental functions.[1] It is not restricted in the hilly Himalayan mountain areas, it has been reported from the sub-Himalayan flat lands (Tarai), plains, riverine areas, deltas and even coastal regions.[2]

The Sundarban delta is the largest mangrove ecosystem of maximum bio-diversity in India. A random study in a rural village of Sundarban delta on a population of 3814 covering all age groups showed over all goiter prevalence 44.5%, along with associated disorders viz. feeble mindedness (49%), hypothyroidism (29%), stunted growth (12%), deaf mute (6.6%), reproductive failure (18%), and stillbirth (4%).[3] In another study on iodine nutritional status among school children conducted in an adjoining rural area of the Gangetic West Bengal showed that in spite of adequate iodine intake as evidenced by urinary iodine level, the total goitre prevalence was about 38%.[4] Reports on the iodine nutrition of the population in the delta region are not available. The present investigation was therefore undertaken to study the prevalence of goiter and to assess the iodine nutritional status by measuring urinary iodine and consumption pattern of common dietary goitrogen available in the region measuring urinary thiocyanate, iodine content in edible salts and bio-availability of iodine by measuring iodine content in drinking water collected from the Sundarban delta of North 24-Parganas district in West Bengal.

Subjects and methods

The Sundarban delta spreads itself amidst the two districts of North and South 24-Parganas in West Bengal. It has as its boundaries the Hooghly River in the west, Bangladesh in the east, Bay of Bengal in the south and Dampier Hodges line in north and covers an area of 9630 sq. Km. of land in West Bengal.[5] It is an archipelago of 54 islands, full of unnumbered rivers and creeks. It has population of 31, 20, 986 (2001 Census Report) living under 19 Community Development Blocks (CD Blocks) of which 13 are in the district of South 24-Parganas and the rest 6 are in North 24-Parganas district. Each CD Block consists of about 100-120 localities or villages. Most of the villages have a primary school and a secondary school covers nearby 8-10 villages. To get the proper representation 6 areas/localities were selected from 6 CD Blocks of North 24-Parganas taking one from each by random purposive sampling.[6]

Correspondence address: Dr. Amar K Chandra, Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta, 92, Acharya Prafulla Chandra Road, Kolkata 700009, India
E-mail address: amark_chandra@yahoo.co.in
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Population studied

In each selected area, one primary school annexed to a nearby secondary school was randomly chosen where the students of both sexes and age group 6-12 years were available as recommended by WHO/UNICEF/ICCIDD.[7] However, in areas where children of both sexes in the age group 6-12 yr were not available, one primary and one secondary school for boys and another secondary school for girls were chosen at random. In this way 2050 students were clinically examined for the enlargement of thyroid gland.

Clinical goiter survey

The clinical examination of each child was conducted by palpation method for goiter and grading was done according to the recommended criteria of WHO/UNICEF/ ICCIDD[7] [grade 0, no goiter; grade 1, thyroid palpable but not visible and grade 2, thyroid visible with neck in normal position]. The age of the students was recorded from the school register and was rounded off to the nearest whole number.

Iodine and thiocyanate in urine

Spot casual urine samples were collected from 40 children in each area irrespective of their thyroid status from the clinically examined enrolled students at a definite interval maintaining proportionate representation from the entire population of the studied school(s) following WHO/UNICEF/ICCIDD criteria[8] in wide mouth screw capped plastic bottles adding a drop of toluene to inhibit bacterial growth and minimize bad odour. Iodine in urine was determined by the arsenite method following dry ashing in presence of potassium carbonate[9] maintaining Internal Quality Control having a known concentration range of iodine content with each batch of test samples. In case of higher values, samples were diluted two to five times with double distilled water to get the appropriate result. Urinary thiocyanate concentration was measured from the same collected urine samples used for the analysis of iodine by the method of Aldridge[10] and modified by Michajlovskij and Langer.[11]

Iodine in salt and water

To monitor the iodine content of salt samples available in the area, 35 marked airtight plastic containers were distributed[12] at random to the students of the studied schools and they were asked to carry samples of edible salt from their households the next day. The salt samples were kept at room temperature in the laboratory and iodine content was measured within a week following the iodometric titration method.[13] To cover the entire studied region 48 drinking water samples were collected at random taking 8 samples from each area from the shallow tube wells, in the screw capped plastic bottles, brought to the laboratory, kept at 4°C and its iodine level was measured following the method of Karmarkar *et al*.[9]

Statistical methods

Mean, standard deviation and median values have been used to describe the data as appropriate. Pearson's product moment correlation coefficient (r) was computed to find out the relationship between median urinary iodine and mean iodine content in drinking water. The study was conducted within February- December 2004.

Results and Discussion

The overall goiter prevalence of school children in the Sundarban delta of North 24-Parganas was 33.1%. Though most of the goiter is palpable (30.4%) but the prevalence of visible goiter (2.7%) among the children of 6-12 yrs also exist (Table 1). Thus as per clinical criteria of WHO/UNICEF/ICCIDD[14], IDD is a severe public health problem in the region. Urinary iodine is the most important biochemical indicator that indicates current state of iodine nutrition also used as a valuable indicator for the assessment of IDD because 90% body's iodine is excreted through urine.[8] The indicator of iodine deficiency elimination is a median value for urinary iodine (MUI) concentration of 100µg/l, i.e 50% of the samples should be above 100 µg/l, and not more than 20% of samples should be below 50µg/l.[15] In all the six studied areas MUI was well above 100µg/l (Table 2).

Table 1. Goiter prevalence in different study areas of Sundarban delta, District North 24-Parganas

Sl No.	Study areas (C.D. Blocks)	Total number of children examined	Number of children with goiter			Severity as public health problem
			Grade-1	Grade-2	Total (1+2)	
1	Hasnabad	452	173 (38.3)	15 (3.3)	183 (41.6)	Severe
2	Sandeshkhali I	352	103 (29.3)	16 (4.5)	119 (33.8)	Severe
3	Hingalganj	341	106 (31.1)	05 (1.5)	111 (32.6)	Severe
4	Haroa	250	72 (28.8)	02 (0.8)	74 (29.6)	Moderate
5	Sandeshkhali II	271	72 (26.6)	08 (2.9)	80 (29.5)	Moderate
6	Minakhan	384	98 (25.5)	10 (2.6)	108 (28.1)	Moderate
		2050	624 (30.4)	56 (2.7)	680 (33.1)	Severe

Severity of public health problem: 5.0-19.9% mild; 20.0-29.9% moderate; >30% Severe[14]

Table 2. Urinary iodine and thiocyanate excretion of studied population and iodine content in salt and drinking water of Sundarban delta, North 24 Parganas

Sl. No	Study areas (C.D. Blocks)	Urinary iodine levels (μg/l)			Urinary thiocyanate (USCN) level mg/dl Mean ± SD	Percentage of salt samples containing iodine >15 ppm	Iodine content in drinking water μg/l
		Median	% urine samples <100 μg/l	% urine samples <50 μg/l			
1	Hasnabad	225	7.5	-	0.857 ± 0.41	65.7	60.2 ± 2.1
2	Sandeshkhali I	220	12.5	2.5	0.746 ± 0.23	74.3	70.8 ± 3.4
3	Hingalganj	185	22.5	2.5	0.760 ± 0.41	60.0	55.4 ± 2.5
4	Haroa	110	40.0	15.0	0.685 ± 0.39	42.9	20.2 ± 2.9
5	Sandeshkhali II	165	32.5	15.0	0.569 ± 0.35	71.4	44.6 ± 1.9
6	Minakhan	190	12.5	7.5	0.846 ± 0.33	77.1	49.6 ± 2.8
		200	21.3	7.1	0.708 ± 0.38	65.2	48.9 ± 30.7

No. of urine samples from each area= 40; Total urine samples=240; No. of salt samples from each area- 35; Total salt samples=210; No. of drinking water samples from each area=8; Total water samples=48

In addition urinary iodine values less than 50μg/l in more than 20% sample was not found in any of the areas suggesting that as per WHO/UNICEF/ICCIDD there is no biochemical iodine deficiency or no inadequacy in iodine intake of the overall population. WHO/UNICEF/ICCIDD further recommends, 90% of the house hold should get iodised salt at the level of 15 ppm[15] but the study shows that in overall 65.2% of house holds are consuming salt at adequacy level (Table 2). In spite of that MUI of the studied population was more than 100 μg/l because of the bioavailability of iodine through food and water. Zeltser *et al.*,[16] have categorised the iodine deficient zone having iodine less than 4 μg/l of water; moderate deficient zone with iodine level 4-10 μg/l of water and the relative deficient zone having iodine level 20 μg/l of water. According to these criteria, the region should be considered as iodine sufficient zone as evidenced by iodine content in drinking water (Table 2). A positive correlation ($r = 0.96$; P=0.002) was found between the iodine content in drinking water and urinary iodine level further showed that consumption of iodine rich food and water was perhaps responsible for high MUI of the population and was enough to fulfil the inadequacy of iodine in salt available in the region.

The consumption of cyanogenic plant foods (e.g cabbage, cauliflower, radish, mustard, turnip) was also evident from the urinary excretion of thiocyanate (SCN). In India, large numbers of cyanogenic plants (SCN precursors) are used as common vegetables and IDD thus persists in many such regions in spite of recommended iodine intake.[17-19] Indian cyanogenic plant foods that are used as common vegetables have potent anti-thyroid activity and supplementation of extra iodine even fails to counteract their effect.[20] In a recent country wide study conducted by Marwaha *et al.*,[21] reported that thiocyanate appears to play an important role in goiter formation especially among poor children in India in post iodization phase. It has been mentioned that the mean value obtained from non-endemic population was 0.504 ± 0.197 mg/dl. In our present study, the mean urinary thiocyanate value was 0.708 ± 0.38 mg/dl. So, the involvement of thiocyanate thiocyanate or thiocyanate precursors present in foods consumed by the people of the region may not be ruled out because the people of the region often consume those foods. Besides this, Sun-darban delta is made up of sedimentary rock because the deltas are the accumulation of sediments at the end of the channel where it discharges into standing body of water, the seas and the oceans i.e. Bay of Bengal.[22] Presence of sedimentary rocks rich in organic matter are the main source of water borne goitrogens because it contains resorcinol, phthalate esters, aliphatic disulphides etc. are potent anti-thyroid compounds.[23] The people use the drinking water from shallow tube well of 150-200 feet deep i.e. the water contaminated with sedimentary rock.

Therefore, the present study indicates that goitrogenic and antithyroid substances possibly comes through food and water may have the role for the persistence of endemic goiter in spite of the consumption of adequate iodine in the studied region. More investigation is thus necessary to arrive at certain definite cause of high goiter rates in the populations.

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Amar K Chandra PhD, Smritiratan Tripathy MSc, Dishari Ghosh MSc, Arijit Debnath MSc and Sanjukta Mukhopadhyay MSc

Endocrinology and Reproductive Physiology Laboratory, Department of Physiology, University College of Science and Technology, University of Calcutta

甲状腺肿大流行和碘营养在西孟加拉北部 24－parganas 的 sundarban 三角州的状况

本研究的主要目的在于评估印度东部西孟加拉北部 24－parganas 区的 sundarban 三角州的学龄儿童（6－12 岁）碘营养的状况。2050 名儿童临床检查了甲状腺，240 份尿样分别分析了碘和硫氰酸盐；还测量了 48 个水样和 210 个盐样中的碘含量。结果显示研究的区域有严重的临床地方性甲状腺肿大流行达 33.1%（一级：30.4%，二级：2.7%），中值小便碘含量为 200 μg/l，显示无生物化学上的碘缺乏，65.2 %的盐样含推荐量的碘含量和饮用水中含足够量的碘，而平均的尿硫氰酸盐含量是 0.708±0.38 mg/dl。尽管摄入了足够量的碘，现有的甲状腺肿流行可能是由于来自食物和水中的饮食致甲状腺肿因子/抗甲状腺的物质所引起。

关键词：地方性甲状腺肿大、致甲状腺肿因子、学龄儿童、尿碘含量、尿硫氰酸盐含量、西孟加拉。